Environment Canada | Environnement Canada

PROCEEDINGS OF FRESHWATER SEDIMENT ISSUES WORKSHOP: JUNE 26, 1986, CHARLOTTETOWN, P.E.I.

WASHBURN AND GILLIS ASSOCIATES

WATER RESOURCES BRANCH
INLAND WATERS DIRECTORATE
DIRECTION DES RESSOURCES EN EAU
DIRECTION GÉNÉRALE DES EAUX INTÉRIEURES

Canada

Atlantic Region

IWD-AR-WRB-86-113

PROCEEDINGS OF

FRESHWATER SEDIMENT ISSUES WORKSHOP

JUNE 26, 1986, CHARLOTTETOWN, P.E.I.

IWD-AR-WRB-86-113

Submitted to: Water Resources Branch
Environment Canada
Atlantic Region
Dartmouth, Nova Scotia

Submitted by: Washburn & Gillis Associates Ltd.
404 Queen Street
Fredericton, New Brunswick
E3B 1B6

Date: November 1986

1986 11 14

Mr. D. C. Ambler, P.Eng.
Senior Project Engineer
Water Resources Branch
Environment Canada
45 Alderney Drive
Dartmouth, Nova Scotia
B2Y 2N6

Dear Mr. Ambler:

We are pleased to enclose the final version of the Proceedings of the Freshwater Sediment Issues Workshop.

Our proceedings have been developed with the consultation and input of many of the participants. We acknowledge their advice and suggestions.

We have enjoyed working on this interesting assignment, and we hope that its outcome leads to new directions in freshwater sediment programs in Atlantic Canada.

Yours truly,

Norman Gridley
per NCG.

Norman C. Gridley, P.Eng.
Workshop Coordinator

TABLE OF CONTENTS

	PAGE
Letter of Transmittal	i
Table of Contents	ii
Abstract	iv
1.0 INITIATIVES LEADING TO THE WORKSHOP	1
1.1 Freshwater Sediment Data Program Review and Recommended Workshop	1
1.2 Individuals Concerned with Freshwater Sediment Issues	2
1.3 Specific Objectives of the Workshop	2
2.0 WORKSHOP PROCEEDINGS	4
2.1 Background	4
2.2 Workshop Program and Time Availability	5
2.3 Workshop Participants and their Affiliations	5
2.4 Abstracts and Synthesis of Individual Presentations	9
2.5 Findings of the Working Groups	32
2.5.1 Quantity and Quality Data Requirements	32
2.5.2 Developing Uniform Standards	33
2.5.3 Research Needs	35
2.5.4 Regional Advisory Group	37
3.0 DIRECTIONS FOR PROGRAM DEVELOPMENT	40
3.1 Introduction	40
3.2 Category I. National Responsibilities of Water Resources Branch or other Federal Government Departments	41
3.2.1 Development of Instrumentation	42
3.2.2 Guidelines for Data Acquisition	44
3.2.3 Publication Format for Data	46
3.2.4 Interpretive Reports for Sediment Stations	48

PAGE

3.3 Category II. Regional Responsibilities of Water Resources Branch Through the Federal/Provincial Coordinating Committees 49

3.3.1 Monitoring Programs 49
3.3.2 Awareness of Programs 52
3.3.3 Regional Advisory Group 52

3.4 Category III. Responsibilities of Government Departments (Federal or Provincial) Managing Natural Resources 54

3.4.1 Resource Evaluation 54
3.4.2 Demonstration Projects 55

4.0 REFERENCES 58

APPENDIX I. LIST OF WORKSHOP PARTICIPANTS
APPENDIX II. ORIGINAL ABSTRACTS AND RESPONSES TO QUESTIONS RAISED TO PRESENTORS DURING THE WORKSHOP
APPENDIX III. OBJECTIVES AND STRUCTURE OF REGIONAL ADVISORY GROUP

ABSTRACT

On June 26, 1986 a workshop on Freshwater Sediment Issues was held at the University of Prince Edward Island in Charlottetown. The workshop brought together individuals from the four Atlantic provinces who are dealing with problems of the source, transport, fate, and environmental effects of sediment in freshwater. Representatives from university, industry, consulting, provincial government, and the federal government took part in the intensive one-day workshop, which included 22 short presentations followed by four simultaneous working group sessions.

The workshop was jointly funded by the Environment Departments of the four Atlantic provinces and the Water Resources Branch of Environment Canada. The initiative of the Water Resources Branch was instrumental in making the workshop a reality.

The results of the workshop have been condensed into proceedings, which provide, first, the rationale for the workshop and its objectives; second, the proceedings themselves, given in a concise format; and third, a series of recommendations for new directions in sediment programs in the region. Recommendations are given which span the full range of sediment issues. The formation of a Regional Advisory Group is suggested for the coordination of research directions and data collection efforts.

1.0 INITIATIVES LEADING TO THE WORKSHOP

1.1 Freshwater Sediment Data Program Review and Recommended Workshop

In 1984 the Sediment Survey Section, Water Resources Branch of Environment Canada (Ottawa) initiated an independent evaluation of the sediment data collection and publication program. Under the direction of the five regional offices of the Water Resources Branch of Environment Canada, regional data program reviews were conducted across Canada. The Atlantic Region review, conducted by Washburn & Gillis Associates Ltd. during 1984, was completed in May 1985 and is summarized in a report entitled "Freshwater sediment data collection and use in the Atlantic provinces."

The 1984 Atlantic Region review investigated sediment problems, concerns and issues, and solicited the views of data users on how the sediment data program could be modified to respond to these issues. Of the many recommendations for changes to the sediment program put forth in the Washburn & Gillis report, one was the conduct of a regional workshop on freshwater sediment issues. It was felt that such a workshop would provide a forum for individuals throughout the region who are dealing with freshwater sediment problems to come together, discuss common concerns, identify research needs, and generally assist the Water Resources Branch to develop new directions for its sediment data program.

Beyond the immediate objective of assisting the Water Resources Branch in pursuing its own responsibilities, the workshop was also intended

to allow the Water Resources Branch to provide a leadership role by creating the opportunity for a wide range of issues and needs to be discussed, and by encouraging other agencies to pursue the solutions to certain sediment related problems.

This report provides the results of the workshop, which was held on June 26, 1986 in Charlottetown, Prince Edward Island.

1.2 Individuals Concerned with Freshwater Sediment Issues

The data program review of 1984 involved the identification of about 150 individuals in the Atlantic Region who are dealing with freshwater sediment problems, and detailed discussions with about 100 selected individuals. Individuals were from industry, consulting, university, federal government and provincial government departments. The same group of persons was contacted to determine their interest in the freshwater sediment workshop, and they were later asked to participate. Ultimately, the workshop involved 41 participants, most of whom were from the original contact list.

1.3 Specific Objectives of the Workshop

The workshop was intended to bring together resource managers, regulators and technical persons from the four Atlantic provinces who are currently dealing with problems concerning freshwater sediments. The primary objectives were:

- to share published and unpublished information;
- to discuss common problems and concerns;

- to identify needs for basic and applied research; and
- to assist in defining the future directions of sediment data programs in the region.

2.0 WORKSHOP PROCEEDINGS

2.1 Background

The concept for the freshwater sediment issues workshop was put forth to the Water Resources Branch in the final report of the data program review (Washburn & Gillis Associates Ltd., 1985). While the concept of a workshop met with general acceptance amongst those who reviewed the final report during the summer and fall of 1985, several months passed before funding support was obtained to pursue the workshop further.

In January 1986, the Water Resources Branch contracted Washburn & Gillis Associates to conduct preliminary work which could lead to a workshop. A preliminary program was developed, and a telephone survey of about 50 selected individuals was conducted to confirm the level of interest. This list was based primarily on the list of contact persons in the earlier study (ibid.). The phone survey revealed that there was sufficient interest to justify the planning for and conduct of a workshop.

Over the next several months, staff of the Water Resources Branch discussed the workshop with representatives from the four Atlantic provinces through the Federal/Provincial Coordinating Committees, in order to secure partial funding support from each of the four provinces. On May 8, 1986, confirmation was received by Washburn & Gillis, authorizing the planning and conduct of the freshwater sediment issues workshop. The workshop was held on June 26, 1986 at the University of Prince Edward Island in Charlottetown, immediately following the 6th CSCE/CWRA Atlantic Region Hydrotechnical Conference.

2.2 Workshop Program and Time Availability

The initial concept for the workshop was based on the assumption that 1-1/2 days would be available. However, at a meeting in April 1986, Water Resources Branch requested that the time be limited to 1 day.

The program for the one-day workshop was developed through discussions with the Water Resources Branch and through the consideration of comments received from workshop invitees. The listing of the final program is provided in Table 1. This listing represents the actual workshop program as it took place on June 26. The program was subdivided into general segments: introduction, monitoring processes, erosion and sedimentation control, regulatory aspects, industry perspective, and watershed approach. There were 22 short prepared presentations with discussion periods, followed by four simultaneous one-hour working group discussions, followed by a final wrap-up session.

2.3 Workshop Participants and their Affiliations

A total of 41 individuals took part in the workshop, all of whom were invited personally. A list of names, affiliations, addresses and phone numbers is provided in Appendix I. The following is a breakdown of the affiliations of attendees:

Federal Government - Environment: 9

Federal Government - Agriculture: 4

Federal Government - Fisheries: 5

TABLE 1

ONE-DAY PROGRAM FOR THE WORKSHOP ON FRESHWATER SEDIMENT ISSUES

NAME	TIME OF DAY	WORKSHOP SEGMENT	TOPIC
Norman Gridley	8:30 AM	Introduction	General introductions and initial comments
Don Ambler	8:41 AM	Introduction	Workshop introduction; sponsorship, goals, and objectives
Dale Bray	8:50 AM	Introduction	Interrelationships of monitoring, controls, regulations: The Workshop
Lien Chow	9:03 AM	Monitoring processes: on land	Runoff-erosion study, Grand Falls, New Brunswick
Jack Burney	9:17 AM	Monitoring processes: on land	Erosion of thawing soils: current results from lab and field testing
Clair Gartley	9:34 AM	Monitoring processes: on land	Farmland survey conducted in New Brunswick for erosion potential
Dale Bray	9:49 AM	Monitoring processes: in stream	Suspended sediment sampling in a small watershed in New Brunswick
	10:10 AM	COFFEE BREAK	
Don Ambler	10:24 AM	Monitoring processes: in stream	Federally sponsored sediment monitoring in the region: Current and future
Ted Yuzyk	10:43 AM	Monitoring processes: in stream	Comments on national directions of the sediment survey program
Tom Pollock	10:55 AM	Monitoring processes: in stream	Federal water quality monitoring programs in the region & their relevance

TABLE 1 (Cont'd)

NAME	TIME OF DAY	WORKSHOP SEGMENT	TOPIC
Barry Sabean	11:11 AM	Monitoring processes: in channel bed	Sampling program for channel sediments in Stewiacke River, Nova Scotia
Herman Van Groenwoud	11:24 AM	Monitoring processes: in channel bed	Channel bed sampling in Narrows Mountain Brook, New Brunswick
Clair Murphy	11:38 AM	Monitoring processes: in channel bed	West River/Clyde River Estuary water and sediment monitoring program
Norman Gridley	11:55 AM	INTERIM SUMMARY	Summary of sediment monitoring programs; highlight of similarities
	12:05 PM	LUNCH BREAK	
Jean-Louis Daigle	1:05 PM	Erosion and sedimentation control	Implementation of control measures on agricultural lands in New Brunswick
John Theakston	1:20 PM	Erosion and sedimentation control	Control measures at construction sites: a manual
Brian Jollymore	1:34 PM	Erosion and sedimentation control	High speed sieve analysis: a method for assessing proposed on site controls
Rod MacLennan	1:45 PM	Erosion and sedimentation control	Streambank erosion and stabilization techniques in Nova Scotia
Rick McCubbin	2:05 PM	Erosion and sedimentation control	Sediment control through best practicable technology (a case study)
Martin Goebel	2:22 PM	Regulatory aspects	Sediment control regulations adopted for use in Newfoundland

TABLE 1 (Cont'd)

NAME	TIME OF DAY	WORKSHOP SEGMENT	TOPIC
Nabil Elhadi	2:38 PM	Regulatory aspects	Sediment control regulations adopted for use in New Brunswick
John Gilbert	2:54 PM	Regulatory aspects	Sediment control criteria from the provincial perspective in New Brunswick
Pat LeBlanc	3:03 PM	Regulatory aspects	Use of the Fisheries Act for regulating sediment inputs into freshwater
	3:30 PM	COFFEE BREAK	
Dave Taylor	3:45 PM	Industry/proponent perspective	Pipeline construction and stream sedimentation
Gwen Vessey	4:02 PM	Watershed management approach	Watershed management - a new approach to an old problem
	4:15 PM	FOUR SIMULTANEOUS WORKING GROUPS	
		1. Quantity and Quality Data Requirements	
		2. Developing Uniform Standards	
		3. Research Needs	
		4. Regional Advisory Group	
	5:00 PM	REPORT BACK FROM EACH OF THE FOUR WORKING GROUPS	
	5:20 PM	WORKSHOP WRAPUP AND ADJOURNMENT	

Provincial Government - Environment: 7

Provincial Government - Agriculture: 4

Provincial Government - Fisheries: 2

University : 4

Consulting : 4

Industry : 2 Total = 41

2.4 Abstracts and Synthesis of Individual Presentations

Twenty-two short presentations were given by a range of technical and managerial persons. Abstracts were submitted to the workshop organizers. During the session, questions and comments were received in written form, and for those with time available, answers were given by the authors following the presentations. In the preparation of these proceedings, all questions and comments have been forwarded to the authors of the presentations to solicit their written responses. The written questions and responses comprise Appendix II of this report.

The following pages provide single-page syntheses of each of the short presentations, the discussions which resulted from questions posed to presentors, and the implications for program planning. In some cases we have taken the liberty of "interpolating" or "extrapolating" from the actual discussions to present a point of particular importance.

"Freshwater sediment in the Atlantic region: issues, processes and management"

by Dale Bray, Dept. of Civil Engineering, University of New Brunswick

Abstract

Ideas concerning economics, law, politics, social and religious values are integrated to form our individual "world view" concerning the measurable physical, biological, and chemical aspects of freshwater sediments. Freshwater sediments may be viewed at different levels depending on our education and experience; these are: macro-, meso-, and micro-scales. Individuals view problems associated with freshwater sediments from different points of view including: it has value in the field; it occupies space; it is a contaminant; it is a carrier; it is an "eyesore"; it is a disruptor of aquatic habitats. When forming our "world view" concerning freshwater sediments, it is important to understand the main physical, biological, and chemical processes and interactions associated with freshwater sediment in a particular environment. When managing the land and water resources in a free society, a "tug of war" between the impactor and the regulator will develop to arrive at the "contemporary truth" concerning the controls on freshwater sediments. Given this general background, the proceedings for the one-day workshop will focus on freshwater sediments in the Atlantic region and will concentrate on the following topics: processes and data requirements; control measures; and regulations.

(No discussion of this presentation; workshop continued directly into the first presentation by Lien Chow.)

"Runoff-erosion study, Grand Falls, New Brunswick"

by L. Chow, Agriculture Canada, Fredericton, New Brunswick

Abstract

The effects of cropping practices on soil and nutrient loss were studied using runoff-erosion plots established at 8% and at 11% slopes near Grand Falls, N.B. The results indicate that the average annual soil loss on the 11% slope during the period 1983-1985 was 0.05, 16.4, and 24.3 tonnes/ha/yr for grain, fallow, and potatoes, respectively. The soil loss of 24.3 tonnes/ha/yr under potatoes was reduced to 1.2 tonnes/ha/yr if the potatoes were planted along the contour.

Chemical analysis of sediment and runoff samples showed that the cost of nutrients lost from the plot of potatoes up and down the 11% slope was about $86/ha (1985) in terms of fertilizer. Considerable reduction in nutrient loss was found on the plot where potatoes were planted along the contour. The study therefore helped to illustrate the benefit to the farmer of modified planting methods which help to control soil and nutrient loss.

Discussion

Removal of field boundaries on fields with no terraces in place (giving larger field units) resulted in an increase in slope length and consequently increased the LS parameter in the Universal Soil Loss Equation (USLE). Based on a study of air photographs taken in the 1940's and 1980's in the Grand Falls area, P. Steven and J.-L. Daigle found that the LS factor increased by 28% on average. Therefore, it would be expected that erosion potential would have increased by this amount.

Implications for Program Planning

1. Studies related to cropping practices should be continued to demonstrate the physical and chemical effects as well as the economics of such practices. Study results would help in assessing cost-benefit aspects of sediment control.

2. The benefits of erosion prevention should be communicated to the farmers through simple means such as fact sheets and brochures.

3. The documentation of significant land use changes should be incorporated with data for sediment stations in order to aid in the interpretation of sediment data.

"Erosion of thawing soils: current results from lab and field testing"

by J.R. Burney, Department of Agricultural Engineering, Technical University of Nova Scotia, Halifax

Abstract

Tests have been conducted, using a laboratory rainfall simulator in a temperature-controlled enclosure, to examine the effects of temperature, crop cover and erosive agent on the runoff, runoff sediment, splash and splash sediment for three typical Prince Edward Island soils. Seventy-two soil cassettes were used in a factorial design. In a follow-up, more in-depth experiment, 144 soil cassettes will be tested for the effects of freeze/thaw cycling, layering, and residue incorporation. A field rainfall simulator for use in cool-season conditions has been constructed and was field tested on frozen soil in April 1986.

Discussion

The 'problem' being addressed is that of soil erosion in an agricultural sense and non-point source pollution in an environmental sense. From an agricultural perspective the aim is to retain soil in place, while from an environmental perspective soil and chemicals are undesirable additions to the freshwater and estuarine environments. The problem of cause and effect is a continuum; the problem, therefore, cannot be eliminated but only controlled at a tolerable level. The costs of soil and crop management practices must be weighed against the benefits of long-term crop productivity and maintenance of environmental quality.

The source of the problem is agricultural, but degradation of the land and deposition of pollutants is environmental, and agencies other than agriculture have concerns and responsibilities. An interagency co-operative effort would help in coordinating research and setting guidelines for acceptable farming practices and subsidy levels.

Implications for Program Planning

1. The costs of improved soil and crop management practices can be more readily determined than the benefits of reduced land degradation and maintenance (or enhancement) of environmental quality. More work needs to be conducted to identify costs and benefits associated with agricultural soil loss and its effects.

2. A co-operative (multiple agencies, different levels of government) effort is required to coordinate research into freshwater sediment problems and to develop guidelines for the types of on-land activities which can control erosion and soil loss from agricultural lands.

"Farmland survey conducted in New Brunswick for erosion potential"

by C. Gartley, New Brunswick Department of Agriculture, Florenceville

Abstract

Surveys were carried out in the Grand Falls area and the Wicklow area of New Brunswick to determine the history of the land development and soil erosion control activities, in order to provide a rough estimate of the severity of soil erosion.

Soil erosion estimates were calculated from five randomly selected farms in each of the two areas. These estimates indicated that the average erosion rate was from 2.6 to 3.3 times the tolerance rate of 10 tonnes per hectare per year. Field observations indicated that much of the eroded soil is deposited near the boundaries of the fields, but more study is required to quantify the relative amount of such deposition.

Discussion

Most of the farmers who have implemented permanent erosion control measures in the two areas have received technical and financial assistance from the New Brunswick Department of Agriculture and/or Agriculture Canada. Some farmers have undertaken other crop rotation and management changes on their own to reduce erosion and improve crop production efficiency.

Most soil erosion in the New Brunswick potato belt occurs during periods when the soil surface is bare or has little protection and when there is runoff as a result of snowmelt and/or rainfall with an intensity greater than the infiltration rate at the time of occurrence. These conditions are most prevalent in the spring; however, severe erosion events have been experienced during summer and fall on fields used for row crops such as potatoes and beans.

It is difficult to state how much agricultural soil that is eroded from the land is transported to streams and rivers in New Brunswick. It is apparent that soil from fields, forests, ditches, etc. must be moving into the river as a result of high intensity rainfall and/or snowmelt events. If the relative contributions of sediment to the stream from the different sources were known, it would help to determine who should be responsible for reducing the amount of erosion and to direct the implementation of mitigative measures.

Implications for Program Planning

1. Data should be obtained to demonstrate the effectiveness of typical erosion control measures in the potato belt in New Brunswick.

2. The relative production of sediment from different types of land use in the New Brunswick potato belt should be quantified.

3. The problem of sediment delivery ratio for agricultural lands needs to be evaluated for typical field sizes in the potato belt in New Brunswick.

"Suspended sediment sampling in a small watershed in New Brunswick"

by Dale Bray, Dept. of Civil Engineering, University of New Brunswick

Abstract

Detailed manual suspended sediment sampling was carried out on Corbett Brook in Fredericton, New Brunswick during three significant rainfall events during the summer of 1982. These data clearly illustrate that one or two samples a day are inadequate to determine the mass of sediment transported from such a small basin (drainage area of 12 km^2) during periods of intense rainfall. The data also show the variation of discharge, suspended sediment concentration, and conductivity with time. It was found that suspended sediment concentrations could be correlated with turbidity units for concentrations less than 1000 mg/L. Studies should be encouraged in this region to evaluate the use of continuous turbidity measurements to estimate the variation of suspended concentration with time.

Discussion

These data and the results of other studies indicate that for basins smaller than 100 km^2, suspended sediment data should be obtained at time intervals of one hour or less. In this basin, much of the mass of sediment from a given rainfall event was transported out of the basin during a six hour period. Since Environment Canada's current method of obtaining field measurements from streams is manual, it is clear that if the storm causing such a runoff event occurs during the night, it is probable that much of the suspended sediment will pass the station without a single field measurement. Furthermore, the estimated suspended sediment concentration peak would be obtained with little data near the peak of the runoff event. Therefore, there can be considerable error in the published daily suspended sediment loads, particularly for watersheds with drainage areas less than 100 km^2.

Suspended sediment samples were obtained using the depth integrating DH-48 hand held sampler. Sample analysis was in accordance with standard methods, which involved passing the sample through a 0.45 um pore size glass fibre membrane filter. If material were to pass through this filter, it would not be measured as a part of the suspended load.

Implications for Program Planning

1. Environment Canada sediment sampling strategies in rivers with drainage areas less than 100 km^2 should be re-evaluated. The potential for error should be assessed. Automatic monitoring should be established in those basins where it is warranted.

2. Research should be conducted into the use of turbidity measuring devices for continuous monitoring of suspended sediment concentration. Tests should be conducted to see if turbidity is a function of the particle size distribution of suspended sediment.

3. Since different pore sizes are employed, research should be conducted into the effect of using different pore size glass fibre filters on the resulting suspended sediment concentrations.

"Federally sponsored sediment monitoring in the region: Current and future"

by D. Ambler, Water Resources Branch, Environment Canada, Dartmouth

Abstract

The freshwater sediment survey program in Atlantic Canada operated by the Water Resources Branch of Environment Canada has developed since 1965 and now includes 17 sampling stations. The present distribution of stations is not considered to form a suspended sediment network. Most stations are sampled from 60 to 100 times a year.

Outputs from the sampling program are primarily daily suspended sediment concentrations and loads based on continuous observed river stage and periodic suspended sediment data.

The future freshwater sediment survey program has been suggested in an implementation plan developed by the Water Survey of Canada Division, Atlantic Canada. Fifteen recommendations are to be implemented as financial and human resources permit over the next 5 to 10 years.

Discussion

The sediment survey program of the Water Survey of Canada Division of the Water Resources Branch, Atlantic Region has traditionally been a collection and publication program. Studies related to sediment sources and sediment control are not in the mandate of the program; however, the Hydrology Division of the Water Resources Branch can initiate and cooperate in studies which broaden the Branch's role.

Each station used to obtain suspended sediment data within the Water Survey of Canada program is located at a hydrometric station. The establishment of all stations has resulted from a specific need even if the only need has been to monitor baseline suspended sediment concentrations and loads.

Based on previous data, it has been determined that for certain stations, 'significant' suspended sediment does not move in the lowflow winter months.

Land use data should be incorporated with the station history. It is conceivable that this will be facilitated through the Lands Division of the Water Planning and Management Branch, Inland Waters Directorate.

Implications for Program Planning

1. The Water Resources Branch should be encouraged to produce interpretive reports for sediment stations in the Atlantic region for which sediment data are already available. Such reports have been produced for selected stations in other parts of Canada.

2. Studies should be initiated to clearly define the relative contributions of the sediment load through the year.

3. Efforts should be made to have some land use data appended to each record of the station history.

"Comments on national directions of the sediment survey program"

by Ted Yuzyk, Sediment Survey Section, Environment Canada, Ottawa

Abstract

As a consequence of a national review of the Sediment Survey Program, the Water Resources Branch of Environment Canada has recognized the importance of such aspects as the need:

- for data interpretation, both to guide data collection programs and to maximize the information content of existing data bases;
- to consider the role of sediment in environmental (e.g. fisheries) and water quality (e.g. sediment chemistry) applications;
- to complement sediment monitoring with a range of special studies, such as investigations into source, transport, and fate of sediments;
- to improve communications with users and technical professionals; and
- to emphasize the Water Resources Branch's traditional roles in methods, equipment, standards and training.

In response to the national review, the Sediment Survey Program is moving towards a more broadly applicable program that addresses current issues, while simultaneously maintaining and strengthening its capabilities in methods, equipment, standards, sampling strategies, etc. required for monitoring.

Discussion

A variety of research projects being commissioned or conducted by the Sediment Survey Section are underway. One such project is a pilot study to assess sediment sources and linkages for a portion of the Oldman River in Alberta using Cesium 137 concentration measurements from channel and upland sediment samples.

Individuals on the Environment Canada mailing list will receive notification of reports produced by the Sediment Survey Section. However, there may be need for improved mechanisms for technology transfer.

The Sediment Survey Section believes that an integrated approach is needed to address today's range of freshwater sediment issues. Therefore, the section has encouraged and assisted in the planning and conduct of workshops such as this one.

Implications for program planning

1. Research projects being commissioned or conducted by the Sediment Survey Section must be better publicized to the data users at the regional and local level.

2. Improved interaction is required between the Sediment Survey Section and the data users in order to better define research needs and thereby ensure that research subsequently conducted is of relevance.

"Federal water quality monitoring programs in the region and their relevance"

by Tom Pollock, Water Quality Branch, Environment Canada, Moncton

Abstract

Water quality programs of the Water Quality Branch measure the physical and chemical parameters of the aquatic environment. This includes the water column, suspended sediments, bottom sediments, flora and fauna. The history of water quality sampling is followed from early industrial water supply suitability studies, through the phase of terrestrial inputs to the oceans during the International Hydrological Decade, to the present-day issues of maintenance of boundary water quality, effects of long range transport of air pollutants, and toxic chemicals from agriculture, forestry and waste disposal.

Discussion

Workplans of the Water Quality Branch are primarily based on national programs, but are also influenced by participation in interdepartmental groups, intergovernmental groups, and informal discussions with scientists and managers who work with the aquatic environment. Negotiations are presently under way with each of the provinces to establish bilateral water quality agreements aimed at improving the coverage and interpretive potential of monitoring sites.

Some programs are issue driven, such as pesticides, toxic substances, and long range transport of air pollutants. The parameters monitored in each program are chosen from the compounds of concern to the intergovernmental agencies that are regulating toxic substances or studying particular issues. Specific compounds for monitoring are selected by taking into account usage patterns and available laboratory methodologies for analysis at trace levels.

A study is under way in Alberta which is examining the movement of sediment from farmland to stream with a radioactive tracer (Cesium 137). The use of pesticides for such tracing purposes would be far more difficult because of their non-conservative nature and because of the difficulty in identifying and quantifying the variety of breakdown products.

Implications for Program Planning

1. The use of interdepartmental and intergovernmental committees for development of water quality monitoring programs is strongly encouraged, and perhaps should be made more open to suggestions from non-governmental persons who are concerned with water quality. These committees should make their work known to individuals who are interested in their objectives and recommendations.

2. Where applicable, the existing programs of the Water Quality Branch should be closely coordinated with the programs of the Water Resources Branch which involve suspended sediment and bed load monitoring. Such coordination would improve the usability of results and would limit duplication of effort.

"Sampling program for channel sediments in Stewiacke River, Nova Scotia"

by Barry Sabean, Nova Scotia Department of Lands and Forests, Kentville

Abstract

A study was carried out to evaluate the causes and results of sediment input from several point sources along a gravel-bed river. Open wide-mouthed bottles were adopted as silt traps above and below identified point sources. Core samples of substrate were also obtained along the channel to provide measures of substrate composition and distribution. Over a 64-km reach of river, 106 core samples were obtained. Results from the silt traps were inconclusive; however, the core sampling revealed an increase in percent fines in the downstream direction.

Discussion

The size of the substrate sample used in the study was determined primarily from advice of others and from the literature.

From the perspective of provincial fisheries management, a primary data requirement is the establishment of a relationship between sediment inputs to the stream and the quality of the substrate along the channel.

Although fine sediment particle sizes seem to have an influence on the fisheries resource in other environments, it is not possible to definitively link the two in the Stewiacke River channel.

Some land use data were available, but the qualitative aerial and field observations were adopted to provide a 'feel' for the relative significance of different sediment sources. The results of the the study did not implicate any one activity as being the primary contributor of sediment to the stream.

Implications for Program Planning

1. Guidelines need to be established to provide uniform advice regarding the sampling of substrate materials. For example, the mass of a bed material sample should be related to the mass of the largest particle to be sampled.

2. A standard method needs to be developed for evaluating the size and rate of infilling of substrate material with fines.

3. A demonstration project is required to evaluate the interaction of fines with the substrate of a gravel-bed river.

4. Guidelines need to be established to quantify those areas of the basin which contribute the majority of sediment of specific sizes to the stream.

"Channel bed sampling in Narrows Mountain Brook, New Brunswick"

by Herman van Groenewoud, Canadian Forestry Service, Agriculture Canada, Fredericton, New Brunswick

Abstract

The deposition and removal of sediment in stream bottoms was studied for a four-year period in the Narrows Mountain Brook in central New Brunswick in which forest clearcutting took place during 1978-79. Vortex samplers were used to study the bedload movement; these consisted of samplers constructed across the stream which were intended to trap all material being moved by the water as bedload. Among the coarse sand and fine gravel fractions, little bedload movement was found. Frozen-core samples were used to study the distribution of fines in the brook bottom. Significant concentrations of fines were not present before clearcutting. The study found that clearcutting per se did not cause sedimentation. However, road construction and culvert installation resulted in the deposition of 10-15 cm thick layers of sediment for 50 m below culverts. During the first four years of study, little movement of this sediment was observed; however, seven years later it was observed that this sediment had been washed out. Further studies will be required to determine where this sediment ultimately settled. The project shows that stream bottoms in undisturbed streams are normally very stable, and only large streamflows will initiate large-scale bedload movement which will wash out sediment.

Discussion

The study attempted to determine the fate of sediments over time using frozen core samples, but over a four year period little movement occurred. A recent visual observation after a seven year period showed that the sediment below culvert installations had moved, but its destination was unknown.

Many streams are subjected to more risk of environmental disruption than this one, which may result in a greater deposition of sediments from watershed activities. The implication, therefore, would be that a greater period of time would be required to wash out deposited sediments.

Implications for Program Planning

1. The methods for sampling bed load movement into and out of streams which are under development pressure are not well established. The agencies which have expertise in this regard (such as the Sediment Survey Section) should provide advice to other government agencies who are planning such studies.

2. The results of regional studies examining sediment movement problems in rivers should be made more available to researchers and technical persons in the region, perhaps through a regional mailing list coordinated by Environment Canada.

"West River/Clyde River Estuary water and sediment monitoring program"

by Clair Murphy, Marine Environment Section, P.E.I. Dept. of Community and Cultural Affairs, Charlottetown, Prince Edward Island

Abstract

A water quality and sediment monitoring program is presently being undertaken in the West River/Clyde River estuary by the Marine Environment Section of the P.E.I. Department of Community and Cultural Affairs. The purpose of the project is to develop a data base that will define some of the physical, chemical, and biological characteristics of the semi-impounded West River/Clyde River system prior to the completion and operation of an additional deep channel bridge opening in the West River Causeway.

Discussion

A causeway with a narrow opening significantly restricts the volume of tidal exchange at the West River Causeway. After many years of persistent effort by individuals and groups, work is presently under way to construct a wide, deep channel opening that is predicted to pass in excess of 95% of the natural tidal prism.

The West River/Clyde River system does not have any significant inputs of domestic or industrial sewage. A watershed inventory done in 1978 showed that 67.6% of the total watershed area is devoted to agricultural land use; of this, 48.2% was in hay or pasture, 25.2% was grain, 6.3% was in row crops, and 20.3% was idle. The present distribution of land use types is expected to be similar to that measured in 1978.

The Universal Soil Loss Equation has not been used in this study to estimate farmland erosion, but it may be applied later. During the study, watershed inventory surveys will be used to identify at least the major sources of silt to the water course.

Implications for Program Planning

1. In the design and implementation of a monitoring program which is to quantify the effects of construction projects on the marine environment, interjurisdictional communication is essential. In this case, communication between engineers and biologists is required.

2. At this project site, sediment deposited in an estuary due to a tidal restriction has not been quantitatively identified as to sources due to lack of data. More data are needed to quantify the relative contribution of various types of land use to sediment loadings to rivers in Prince Edward Island.

"Implementation of control measures on agricultural lands in New Brunswick"

by Jean-Louis Daigle, New Brunswick Department of Agriculture, Grand Falls, New Brunswick

Abstract

Since 1948, the New Brunswick Department of Agriculture has experience with various erosion control measures with differing degrees of success. The "Variable Grade Parallel Diversion Terrace System", used in combination with grassed or rock-lined waterway outlets, has gained some farmer acceptance through the last 10 years. A total of 8,000 acres of cropland have been protected with these structures in the upper Saint John River valley. The implementation of successful soil conservation systems requires extensive planning, field surveys, designs, adequate construction techniques and proper maintenance. The recent Canada-New Brunswick Federal/Provincial Agri-Food Agreement has increased the emphasis on soil and water conservation projects by providing a 66.6% cost-sharing program to implement adequate erosion control systems. In addition, a complementary strip-cropping program at $75 per hectare is available to farmers, and has gained some acceptance in 1986.

Discussion

Over the years, the N.B. Department of Agriculture has contributed from 40 to 66.6% of cost sharing to implement erosion control structures on farms. The payback period to farmers for erosion control, however, is lengthy (10 to 25 years); by contrast, the payback period in tile drainage is short (5 to 10 years).

The economic return to New Brunswick farmers who adopt proper erosion control measures has not yet been studied. Farmers must sacrifice land (and money) to implement erosion control structures; however, they may see improved productivity and maintenance of the land resource. There is a need for field research and demonstration projects in this area in order to promote good soil and water conservation practices.

A farm land survey in the Grand Falls area showed that 55% of potato producers were planning future erosion control projects. Erosion control systems have proven themselves in the Grand Falls area, and their popularity has spread by word-of-mouth among farmers.

Implications for Program Planning

1. The province needs to initiate studies of the economic value of the resources to be protected by erosion control of agricultural lands, in order to aid in cost-benefit analyses of control measures.

2. Demonstration projects to illustrate the effectiveness of on-farm soil conservation practices and erosion control methods are needed. If possible, these projects should encompass the quantification of economic returns to farmers.

"Control measures at construction sites: a manual"

by John Theakston, Nova Scotia Department of the Environment, Halifax

Abstract

In response to a growing number of sediment pollution incidents, the Nova Scotia Department of the Environment has developed an erosion and sedimentation control manual which is designed for eventual public distribution and use in controlling accelerated soil erosion caused by construction activities. The manual describes erosion and sedimentation processes and the effects of sedimentation on the environment. Principles and practices for reducing erosion are discussed as the basis for guidelines in submitting an erosion and sedimentation control plan for Departmental approval under the Environmental Protection Act. Included with the manual are Fact Sheets which detail a number of control measures. Sketches and photographs explain where each measure can be applied on a construction site. The advantages and disadvantages, design considerations, and installation and maintenance procedures are described for each of the erosion and sediment control measures.

Discussion

The information in the manual has been developed from similar manuals and technical journals on the subject, as well as the field experience of Departmental staff. Provided the information in the manual is followed by users, the Department is confident that the measures will be effective in controlling common erosion and sedimentation problems. Field testing has not been conducted on each control measure, although the Department recommends that such testing be done.

The manual is intended to serve primarily as a public information document and its recommendations are to be employed as guidelines (not regulations). However, in dealing with a problem of sediment pollution, an order may be issued under the Environmental Protection Act, and it is conceivable that an offender may be ordered to install erosion and sediment control measures as described in the manual.

Implications for Program Planning

1. Field testing of erosion and sedimentation control methods for construction sites should be encouraged. Scientifically rigorous monitoring and reporting during such testing should be ensured, perhaps by maintaining the involvement of engineers and scientists from the Sediment Survey Section.

2. The costs of implementing erosion and sedimentation control devices on or downstream of construction sites should be documented by the province. These costs can then be compared to the anticipated benefits associated with resource protection, ultimately aiding in cost-benefit analyses. The estimation of dollar benefits from resource protection may be far more difficult, however, than quantifying costs of erosion and sediment control.

3. Demonstration projects for site specific erosion control methods should be implemented for evaluating effectiveness at selected construction sites.

"High speed sieve analysis: a method for assessing proposed on site controls"

by Brian Jollymore, Fisheries and Oceans Canada, Halifax, Nova Scotia

Abstract

The release of sediment can have a serious effect on the fishery resource. Construction activities on certain terrain configurations can cause accelerated erosion problems. The technique often utilized to trap suspended solids which have been eroded from construction sites is to construct sediment basins. Two site conditions are generally observed: (1) turbid water in, turbid water out and the sediment basin is presumed not to be working, or (2) turbid water is present and a sediment trap is indiscriminately used. The proposed technique of 'high speed sieve analysis' is to be a quick, inexpensive aid to regulators and contractors to qualitatively assess the seriousness of the problem, which will help in the selection of the type of sediment control system to use.

Discussion

The device is a small, hand-held vacuum system which quickly filters a sample of water in the field. The result is qualitative; if the filter is brown, the conclusion is that the suspended sediment could most likely be removed if the water were to be passed through a sediment trap. If the filter does not collect sediment, the trap will be less effective.

The device proposed uses a 1.2 micron pore size Whatman glass filter paper (GFC), a standard size used by the Department of Fisheries and Oceans' laboratory when dealing with sediment samples. The rationale behind the in-field test of sediment-laden water is: (1) 'brown' water is not always treatable by a sediment trap when the particle sizes are too small; (2) the mere presence of 'brown' water downstream of a sediment trap does not mean that the treatment device is not working; (3) the method was intended to be a quick test, that would help people to determine the seriousness of the problem at hand.

Sediment traps which are installed at construction sites are considered to be a temporary control measure. Once the site is stabilized to prevent further erosion, the need for the trap is ended; the area is cleaned out and the trap is removed. The Department of Fisheries and Oceans generally requests that traps be left in place and maintained until 90% of the site area has been stabilized.

Implications for program planning

1. Methods for quick, in-field testing of sediment laden water to determine the range of particle sizes should be developed and tested under a variety of site conditions. Such methods would help project proponents and regulators in determining whether or not certain sediment control devices would be effective at construction sites. Individuals working with freshwater sediment sampling and analysis should be involved in the development and testing of new in-field methods such as these.

"Streambank erosion and stabilization techniques in Nova Scotia"

by Rod MacLennan, Nova Scotia Department of the Environment, Truro

Abstract

The Province of Nova Scotia has a streambank protection program through which it has conducted erosion protection works on river channels, with most work concentrated in the nine most easterly counties. Some of the causes of these streambank erosion problems include past watershed activities (including gravel mining or gravel pits), clearcutting, and spruce budworm infestations. These natural or man-made problems are then aggravated by unsuitable soil types or steep topographic conditions, resulting in severe bank erosion problems. The results include loss of the land resource (bank erosion rates as high as 6 m/yr have been recorded on Cape Breton Island), debris blockages, gravel bar buildups, ice blockages, and channel realignments. The Province has used riprapping on small and large rivers, and the success rate has been good. Riprap is usually placed with an excavator, and as much as possible of the natural vegetation is preserved. In many cases the work is conducted in the winter months because access in the summer is not adequate.

Discussion

The Province's program of streambank protection involves riprapping. A limited number of gabions have been installed. Although the concept of planting indigenous vegetation is recognized as being of value in streambank protection, it has not yet been employed.

The selection of sites that are to be protected from streambank erosion is generally on a priorities/budgets basis. The first priority is the protection of dwellings, with the protection of the land resource being secondary. It is recognized that such a priority system may not result in the most judicious protection scheme for a given river.

Some persistent morphologic problems, such as those shown along the Margaree River in Cape Breton, may be caused by the presence of an amount of material which cannot be moved by the river, under normal hydrologic conditions, as bed load.

Implications for Program Planning

1. Provincial agencies which are planning and conducting streambank protection works should be kept informed of relevant work being done in the region. For example, work that incorporates riprap, gabions or vegetation in protecting streambanks may be of interest.

"Sediment control through best practicable technology (a case study)"

by Rick McCubbin, Fisheries and Oceans Canada, St. John's, Newfoundland

Abstract

In 1982, Public Works Canada commenced construction of the Institute for Marine Dynamics on behalf of the National Research Council of Canada. The construction of this facility, located in St. John's, involved several massive excavations in close proximity to the Rennies River watershed, an environmentally sensitive area. Fisheries and Oceans Canada requested that Public Works design and implement a sophisticated de-sedimentation facility at the construction site to ensure that sediment contained in site waters did not contaminate the highly productive trout bearing waters of Rennies River. The de-sedimentation facility was a successful mitigative strategy for this site, accumulating in excess of 1,250 metric tons of sediment over the three year life of the project. Concentrations of total suspended solids in waters leaving the site averaged 30 mg/L or less. The cost of the de-sedimentation facility was less than 1/10 of 1% of the total facility capital costs.

Discussion

The de-sedimentation process employed involved addition of alum to the influent to a settling basin at a concentration of 30 mg/L. No aquatic impact monitoring was performed on receiving waters because alum is a relatively inert compound from the perspective of aquatic toxicity, and DFO feels that there was no significant impact on the aquatic ecosystem of Rennies River resulting from alum addition.

Facilities constructed along the Rennies River in earlier years (1970's) did not include sufficient manpower and budget for fisheries habitat protection. The effort expended on de-sedimentation facilities for protection of fish habitat at this site reflects, in part, the efforts of public interest groups, such as the Salmon Association of Eastern Newfoundland, in pressuring DFO to reevaluate its habitat protection priorities. Public interest in the Rennies River is currently quite high.

Implications for Program Planning

1. Projects such as this one which involve direct capital expenditures for protection of the environment through sediment control should be documented and publicized throughout the Atlantic region. If possible the costs and benefits of such projects should be determined in order to guide future decision-making when sediment control devices are being considered.

"Sediment control regulations adopted for use in Newfoundland"

by Martin Goebel, Newfoundland Department of the Environment, St. John's

Abstract

There is clearly a need to control freshwater sedimentation in the Province of Newfoundland and Labrador. This Province uses existing legislation to control sedimentation which can occur through development and construction activities. The Department of Environment Act specifies the jurisdiction of the Department over water resources. Any water body alteration must have prior approval in accordance with the Act. The approval process is used to assess the impact of any project; approval is granted only if there is adequate protection against erosion. Erosion protection is typically specified in several forms as a condition of approval. Deposition of sediments through pumping or other means is considered pollution, and can therefore be controlled. Specific regulations prohibit discharges which would add more than 30 mg/L of suspended solids to a body of water.

Discussion

The Newfoundland Department of Environment has had convictions for pollution but none of these cases were related to sediment deposition; they were related to chemical depositions.

The scientific basis for the establishment of the 30 mg/L incremental limit is not known. This limit is applied in an upstream-downstream manner, through collection of grab samples, and is not dependent upon a time duration of concentrations. Receiving waters are normally sampled near the point of discharge from a given site.

In the experience of the Department, a polluter normally exceeds the 30 mg/L incremental limit by a large amount, such as 100's or 1000's of mg/L, and the pollution is obvious. In these cases, grab samples are usually taken "for the record."

Implications for Program Planning

1. The limits applied to discharges of waters containing suspended sediment are variable throughout the Atlantic region. The scientific basis for these limits should be reviewed. Consideration should be given to spatial and temporal variabilities in background concentrations and in limits or controls. If there is merit, the concept of consistent limits for the region should be developed.

2. The criteria for sampling to assess compliance with limits for suspended sediment concentrations should be developed more fully. The expertise for development and promotion of such criteria rests with Environment Canada.

"Sediment Control Regulations adopted for use in New Brunswick"

by Nabil Elhadi, Water Resources Branch, New Brunswick Department of Municipal Affairs and Environment, Fredericton

Abstract

In New Brunswick, sediment introduction into streams can be controlled by the Watercourse Alteration Regulation and the Water Quality Regulation under the Clean Environment Act. However, there are problems in using these regulations to control sediment loadings to watercourses. These problems relate to the lack of background data on naturally occurring suspended sediment levels, the lack of data transfer techniques between watersheds, and the lack of research information on topics such as bed load transport.

Generally, the Province has used a concentration of 80 mg/L as a maximum allowable concentration for suspended sediment. For the proper enforcement, this limit should be related to background or natural concentrations; it should be qualified as to a specific location below the work site (in relation to stream width); and it should be identified by a certain duration. It would also be helpful to know the downstream uses which may be adversely affected by the introduction of sediment into the channel.

Discussion

There is controversy over the utility and validity of the 80 mg/L concentration which has been adopted. Demonstration projects would be suitable to confirm the limits of suspended sediment concentrations, but apparently such projects have not yet been conducted. The limit is applied independently of the time of year because the value of the resource being affected is not known; limits could not be varied until the potential impacts could be quantified. The 80 mg/L limit is used as a deterrent. which is intended to force the project proponents to control sediment problems.

A system of classifying streams and rivers as to their environmental sensitivities might help in applying limits; however, such a classification system is not used in the Atlantic region by Fisheries & Oceans Canada.

Implications for Program Planning

1. Information on background levels is limited, and more needs to be known about data transferability between watersheds. This may be useful in a general sense but also for detailed studies, when appropriate.

2. The limit (80 mg/L) is applied independently of the time of year or the duration of the event. Obviously more needs to be known about the temporal variability of effects and the significance of short- versus long-term suspended sediment concentrations in the water column on the particular species of fish of concern.

3. The value of the resource which could potentially be affected by sediment is an important key to understanding the need for a stringent limit. A system of classifying streams could help in justifying limits.

"Sediment control criteria from the provincial perspective in New Brunswick"

by John Gilbert, Fish and Wildlife Branch, New Brunswick Department of Natural Resources and Energy, Fredericton

Abstract

The effect of sediment on freshwater fish has been well documented in the literature. Suspended solids can prevent the successful development of eggs and can act directly on fish swimming in the water by reducing their growth rate, reducing resistance to disease, modifying migration routes, and reducing the abundance of food available to the fish. Chronic and short term point source turbidity remains the single greatest factor in limiting fish production in New Brunswick. Provincial biologists need reliable suspended sediment background data on a wide range of watercourses in order to enforce existing legislation and to effectively make fish habitat management decisions.

Discussion

(Discussion of this topic was included in the discussion of the topic "Sediment control criteria from the Fisheries & Oceans perspective" by P. LeBlanc of Fisheries and Oceans Canada and will not be repeated here.)

Implications for Program Planning

1. There is need for suspended sediment data which is representative of baseline or natural conditions from more locations in New Brunswick. More types of watercourses should be represented. These data may be obtained as part of an ongoing monitoring program or on a site-specific basis as needs arise.

"Use of the Fisheries Act for regulating sediment inputs into freshwater"

by Pat LeBlanc, Fisheries and Oceans Canada, Moncton, New Brunswick

Abstract

Under the Constitution Act of 1982, the federal government has legislative jurisdiction over coastal and inland fisheries in Canada. The Fisheries Act provides the Minister of Fisheries with the powers to protect fish and their supporting habitat. The regulation of sediment deposition into coastal and inland waters is done in two ways: the pro-active approach (participating with provincial agencies, such as the watercourse alteration approvals in which Fisheries and Oceans provides technical advice) and the reactive approach (prosecuting violators under the Fisheries Act, through which the deposit of sediment may be considered both deleterious to fish and harmful to fish habitat).

Section 33(1) of the Fisheries Act (damage to habitat) is administered by Fisheries and Oceans, while Section 33(2) of the Act (deposition of deleterious substances) is administered by Environment Canada on behalf of Fisheries and Oceans. Under 33(2) regulations for specific industries (mining, pulp and paper, petroleum) have been developed which provide specific limits of suspended solids; however, no limits have been set on suspended solids from construction or streamside operations. In Atlantic Canada, the number of charges laid for violation of Sections 31(1) or 33(2) has been on the increase.

Discussion

There are some individuals who are not aware that they are damaging fish habitat. However, from the Fisheries and Oceans perspective, certain industries and the public are becoming more aware about sediment problems. In some cases, hefty fines have 'motivated' individuals or industries to 'change their ways.'

In addition to the obvious lethal effects of sediment in watercourses, there are sublethal effects, such as increased likelihood of disease, smothering of eggs, smothering of benthos, and visual effects.

The evidence for proving that suspended sediment in the water column is actually transported into spawning gravels is not available. There are presently no measuring tools for this. Demonstration projects are needed.

Implications for Program Planning

1. Environment Canada should support the establishment of demonstration projects to help answer some current-day problems of freshwater sediments, such as the question of suspended sediment and streambed interaction.

2. Improved interaction is required between the federal and provincial agencies which are responsible for research and regulation of freshwater sediment problems.

3. The provincial agencies should initiate studies of the economic value of resources which are to be protected from damage by instream sediment.

"Pipeline construction and stream sedimentation"

by David Taylor, Sable Gas Systems Limited, Halifax, Nova Scotia

Abstract

A series of selected slides illustrates the sequential nature of pipeline construction along a right of way and the potential sources of sediment inputs to watercourses. These activities may result in impacts on watercourses. However, few if any studies or models developed to date have provided the ability to predict the nature, extent and magnitude of such impacts given basic initial data such as sediment/soil types, streamflows, velocities, channel morphology, bank and slope configurations, etc. There is a need to develop such a methodology in order that industry can employ it in environmental evaluations of projects. One of the key elements in developing this methodology to a level acceptable to both government and industry is mutual understanding and cooperative research and development efforts between the two sectors.

Discussion

In the construction of major capital projects, scheduling often limits the time available for environmental studies. For example, in the planning for a gas pipeline, the application submitted for approval to the National Energy Board is tightly time controlled.

In order to minimize the degree of conflict between government and industry which may result from inflexible guidelines or regulations (such as the 80 mg/L limit which has been applied in New Brunswick), governments should initiate regional environmental studies which can assist industry in answering specific questions as they arise.

The cost to industry for environmental controls can usually be considered money well spent. It can ensure that regulatory 'hassles' and public perception problems can be avoided on the next similar project.

Implications for Program Planning

1. Government and industry should be discussing the areas of research which will lead to a better understanding of freshwater sediment processes related to quantification of potential environmental effects/impacts from major construction projects. Mutual planning and cooperation should be promoted.

2. A better understanding of the 'trade-offs' between environmental protection and costs to project proponents should be developed. The value of the resources being protected by sediment controls should be established.

"Watershed management - a new approach to an old problem"

by Gwen Vessey and Norbert Stewart, P.E.I. Department of Agriculture, Charlottetown, Prince Edward Island

Abstract

Sedimentation is recognized as one of the most serious pollution problems in North America, a situation no less severe on Prince Edward Island. Although the situation would have been somewhat worse without the decade of resource improvement programs, a greater degree of achievement can be a reality through a system of cooperation involving various levels of government and area residents. The key to success for such an arrangement is primarily the initial and on-going input of those most influenced by natural resource conditions.

Discussion (based upon written information from N. Stewart)

Several problems are inherent in current-day resource management methods. First, resource management problems are often investigated by an agency solely in terms of the agency deemed to be a major user of that resource; in the case of soil erosion problems, the evaluation is usually in terms of the influence on agriculture, with little focus on downstream effects. Second, resource improvement programs and projects are often developed by government agencies, although those most influenced have little input except during the implementation stages. Third, few resource management programs have adequate monitoring, and thus they usually have inadequate feedback and little capacity for changes or modifications.

In order to deal with these problems, it is suggested that resource management be viewed on a watershed basis, involving numerous disciplines, with area residents as the prime initiators. There needs to be a change in resource management attitudes, improved communication with government and non-government agencies alike, the establishment of conservation districts, the investigation of new funding mechanisms, and the establishment of a system of data requirement identification, data collection and data analysis. This approach could be considered in the context of a Provincial Conservation Policy. The concept of a watershed approach to soil and water conservation is to be initiated at a workshop in Summerside, P.E.I. in November 1986.

Implications for Program Planning

1. Improved communication is required between government agencies and between non-government agencies in order to enhance the quality of resource management programs at the outset of their development.

2. Monitoring is essential in quantifying the effectiveness of soil conservation programs. Suitable means for practical in-field monitoring need to be implemented as an integral component of conservation programs.

3. An improved system is required for identifying data needs, and for ensuring that proper data collection and data analysis are carried out, when soil and water conservation programs are being designed, implemented and monitored.

2.5 Findings of the Working Groups

At the end of the 22 presentations and discussions, four working groups were convened to discuss particular topics agreed upon by the participants. These groups met for about 45 minutes each; then the full group was reconvened. Reported below are the findings as they were presented during the workshop, which reflect the range of topics considered in the time available for each of the working groups.

2.5.1 Quantity and Quality Data Requirements

This working group was chaired by T.R. Yuzyk of the Sediment Survey Section, Water Resources Branch, Ottawa, and consisted of individuals from various branches of the federal government and from consulting.

The group discussed the questions related to requirements for data on freshwater sediment quantity and quality in the region. It was noted that a variety of agencies are presently collecting sediment data in the region, and that many (perhaps most) are undertaking data programs without the benefit of advice from specialists in Environment Canada. It was agreed that individuals within the Water Resources Branch who are dealing with freshwater sediment should be more available to provide advice, particularly in view of their extensive knowledge and experience in the subject.

There are several research programs which are being undertaken by the Water Resources Branch at the national level. Information about the nature and purpose of these programs is not readily available to data users in the region. Better communication is needed to make users more aware of ongoing research.

The appropriateness of the development of standards for data collection, by the federal government, was discussed. It was generally felt that the federal government is best suited for the development of such standards, and that these standards could be made available to provincial agencies and consultants in the Atlantic region, as well as other regions of Canada. It was noted that the Sediment Survey Section currently considers the development of standards to be a main program objective.

The availability of data has changed over the past few years. For example, the existing water quality summary publications are out of date, and there are no plans to produce new versions; rather, all data are available by computer. However, it was noted that some individuals who cannot obtain ready access to computer systems would probably use the "old" data books instead of the current data. The "true" availability of data was questioned, particularly for consultants from smaller companies. It was noted that water quantity data are updated annually and are available on microfiche.

2.5.2 Developing Uniform Standards

The working group addressing this topic was chaired by Nabil Elhadi of the Water Resources Branch of the New Brunswick Department of Municipal Affairs and Environment, Fredericton.

The group included representatives from provincial and federal government agencies which primarily deal with the regulatory aspects of regulations and acts as well as representatives from industry and consulting.

It was noted that there are many guidelines or regulatory standards related to freshwater sediments that could be addressed. However, the discussion within this working group focused on the establishment of a threshold value of suspended sediment concentration above which a charge may be laid under one of the appropriate provincial or federal acts.

It was noted that within the Atlantic region there are at least four threshold values of suspended sediment concentration that are considered by the various agencies. These are 25 mg/L, 30 mg/L, 50 mg/L, and 80 mg/L. It was also pointed out that it was not always clear: whether these are incremental amounts above a background level; whether the samples are to be taken at a point source input to the stream or at a certain number of channel widths downstream where complete mixing has taken place; whether the source results in a continuous input from an industry or a relatively short duration input from a particular instream project; whether the threshold value is a function of time; and whether the stream has some use which can permit a non-constant threshold value. It is clear that the issue of establishing uniform standards needs to be considered for each stream, even though one threshold value would be easier to administrate.

When considering the establishment of standards, it is appropriate to obtain some estimate of the value of the resource that is being protected in relation to the cost of the protective measures being proposed. It is recognized that this is a difficult task, but it is one that needs to be addressed.

2.5.3 Research Needs

The working group addressing the topic of research needs was headed by T.M. Dick of the National Water Research Institute, Burlington, Ontario.

A major research problem in this region is to connect sheet and rill erosion to the delivery, transport and storage of sediment in and through the river system.

Doubts were expressed concerning the direct applicability of the universal soil loss equation (USLE) to this region for all seasons of the year. The work which is currently going on in this region to establish appropriate factors for the USLE during periods when the soil is frozen should be encouraged and extended.

There seems to be no satisfactory means of establishing the value of the resource that is to be protected by some sediment control measure. Costs for protection methods are often known, but the corresponding monetary benefits are not as readily established, particularly because there are often multiple (tangible and intangible) benefits.

Answers need to be obtained for questions such as: What are the implications of increases in sediment load that contains "undesirable" organic and inorganic pollutants on the biological community? Qualitative answers based on partial information seem to be available but quantitative data and knowledge to substantiate these qualitative answers are not

available. A good example of this topic is the threshold limit on suspended sediment concentration above which there is damage to fish in the stream. Work needs to be done to determine the threshold level for specific fish, for specific seasons of the year, and for specific durations.

It is important to clearly establish the behaviour of water borne sand- and silt-sized particles as they interact with a gravel bed. This interaction is influenced by man-made and natural causes. Since floods are known to cause the movement of finer particles out of coarse sediment beds, it is acknowledged that flood frequency is important in understanding the process. The movement of fines into and out of a coarse sediment bed could be studied at the laboratory level as well as the field level. Many of the fish habitat related questions in the Atlantic region are related to a better understanding of this process.

There is a need to define new, up-to-date equipment for rapid assessment of specific sediment related problems. Such equipment should be portable, rugged, and energy self sufficient.

Operational methodology for carrying out site specific sediment related assessments seems to be lacking. Reliable methods to assess impacts and to evaluate alternatives need to be developed and tested.

There is a strong need for existing research results and knowledge of the behaviour of soil-water systems to be communicated to users and regulators.

Finally it should be recognized that a universal solution to some of the sediment related problems may not be possible. In many cases it may be necessary to carry out site-specific studies to provide workable answers to certain problems. Such studies may be at the demonstration level or they may be at the research level. In some cases, studies may require physical models in laboratories and would require a team of specialists.

2.5.4 Regional Advisory Group

This working group discussed the feasibility of establishing a regional advisory group concerning sediment issues in the Atlantic region, and was headed up by D.C. Ambler of the Hydrology Division, Water Resources Branch, Dartmouth.

The group considered three questions: Why should an advisory group exist; who should be in the group; and how should the group operate.

Why should the group exist?

The advisory group could provide a link for addressing interagency sediment needs on an ongoing basis (such as between the Water Resources Branch and provincial agencies responsible for resource management). For example, it could provide input to agencies that are responsible for the development of instrumentation, or for groups responsible for the establishment of standards for sampling.

The group could provide advice to the Water Resources Branch at the regional level concerning the direction of the current sediment program

based on the perceived needs in the region. In addition, it could give advice to each of the Federal/Provincial Coordinating Committees for Water Quantity Surveys in the Atlantic provinces.

As the group became established it could also provide advice to certain government agencies and to consulting firms.

The group could help to develop research topics that are particularly relevant to the Atlantic region. Such recommendations might assist in the procurement of funds from funding sources. In addition, the group could facilitate the development of agreements to support demonstration projects.

The group could facilitate regional communication and the dissemination of information in the region. For example, the priority for the development of interpretive reports on sediment related questions could be given by the group.

It was acknowledged that the Water Resources Branch of the Inland Waters Directorate should serve as a "center of expertise" on sediment data collection and interpretation.

Who should be in the advisory group?

Although there was inadequate time to formulate the precise structure of the group, it was agreed that it should consist (as a minimum) of representatives from the university community, the agricultural community

(could include the end user of sediment studies - the farmer), industry, consultants, regulators at the federal and provincial levels, and collectors of sediment data.

How should the advisory group operate?

Without having too much time to consider this question, the working group felt that the advisory group should be chaired by a representative of the Water Resources Branch on a provincial basis, in which case there could be four such groups in the Atlantic region. One of the reasons for the provincial groups is that there are physical differences between the four Atlantic provinces. In addition, the Federal/Provincial cost-sharing agreements are set up on a provincial basis. However, there are alternative group structures which could be considered, such as having one advisory group for the Atlantic region.

3.0 DIRECTIONS FOR PROGRAM DEVELOPMENT

3.1 Introduction

A primary objective of the workshop was to develop recommendations that will help the Water Resources Branch to modify its freshwater sediment program in order to better meet the needs of data users in the Atlantic region. In addition, the workshop was intended to provide a forum for the discussion and interchange of ideas between individuals and agencies which may not normally communicate on sediment-related topics. In this regard, it was hoped that the Water Resources Branch could provide a leadership role.

The results of presentations, discussions, and working groups were provided in Section 2. Based on our interpretation of the workshop proceedings, we have developed a number of recommendations for new directions in the program. In the presentation of recommendations, we have frequently inserted in parentheses the names of individuals whose presentations at the workshop related most directly to the point being discussed.

The recommendations presented in this Section are discussed under the following subsections, which are distinguished by the primary source of responsibility and funding support:

1. National responsibilities of Water Resources Branch or other federal government departments,
2. Regional responsibilities of Water Resources Branch through the federal/provincial coordinating committees, and

3. Responsibilities of government departments (federal or provincial) managing natural resources.

The three headings could be expanded, but have been purposely limited to simplify presentation of the recommendations. It is recognized that certain recommendations may, in fact, fall under more than one heading.

Recommendations have been developed considering funding sources, but largely independently of funding (capital or operating) levels. While it is recognized that adequate funding is essential to effective implementation of recommendations, it must be noted that the estimating of funding requirements is beyond the scope of the Freshwater Sediment Workshop or its proceedings. The various recommendations should be considered as desirable courses of action, which can be followed as funding and priorities allow.

The recommendations provided below should be considered in conjunction with the recommendations given in the Atlantic Region review of the sediment data program (Washburn & Gillis Associates Ltd., 1985).

3.2 Category I. National Responsibilities of Water Resources Branch or other Federal Government Departments

Recommendations in this category are considered to be the primary responsibility of tne Water Resources Branch at the national level.

3.2.1 Development of Instrumentation

The recommendations concerning instrumentation do not explicitly consider the source of the funding required. It is implicitly assumed that the Water Resources Branch headquarters and the Environment Canada research institutes will have to provide much of the funding for such instrument development if it is to be considered to be the lead group in sediment-related issues in Canada.

Instrumentation related to sediment studies may include those instruments that are directly applicable to the on-going monitoring program and those that are not directly related to the monitoring program.

Ongoing Monitoring Program

For basins having an area greater than about 100 km^2, a manual sampler may be adequate to obtain a measure of the sediment concentration and hence suspended sediment transport rate when the concentration is coupled with the corresponding flow rate. For basins smaller than 100 km^2, it is almost always necessary to use an automatic sampler or to use a turbidity meter for obtaining the general trend of suspended sediment concentration with time (Bray).

R.I.1. It is recommended that work be carried out by the Water Resources Branch through CCIW to develop a reliable, rugged, turbidity meter (or similar device) for continuously monitoring suspended sediment concentration.

Non-monitoring Program

There are many cases where data for research or for other projects should be obtained by instruments that are widely accepted and have been developed on reliable physical or chemical principles. For example, when evaluating the influx of sediment into a gravel bed, several techniques are available to determine the change in the relative amount of fines in specified levels of the bed over time. These may include core samples, frozen core samples, or wide-mouthed containers placed such that the mouth is flush with the channel bed (Sabean, Groenewoud, Murphy).

Another example that is becoming of more interest is an instrument for determining in situ hydraulic conductivity of a river bed. Individuals carrying out such research should be able to use an instrument that is reliable and is widely used in Canada.

R.I.2. It is recommended that a catalogue of instruments for sediment related problems be formulated by the Water Resources Branch and that an effort be made to develop and test appropriate instrumentation as real needs arise.

During the workshop, interest was expressed in the development of an instrumented vehicle that could be assigned to a specific short term study on a relatively small watershed. Such a vehicle could include recording rain gauges, recording turbidity meters, recording stage recorders, etc. All such instrumentation would be controlled by a microprocessor and could be a complete and independent unit. The unit could

be made available to various agencies for demonstration projects, for short term research projects, etc.

R.I.3. It is recommended that consideration be given to this idea by Water Resources Branch to determine if it is feasible and if there is justifiable demand for such a practical (but likely expensive) mobile instrumentation laboratory.

In general, ideas for instruments and needs for instruments should be presented to the Atlantic Region Advisory Group (see R.III.6 below) and if appropriate be forwarded to the Sediment Survey Section, Water Resources Branch for further evaluation and development if appropriate.

R.I.4. It is recommended that the Sediment Survey Section be the lead agency for the development and/or testing of instrumentation for the monitoring program and in many cases for the non-monitoring programs related to sediment issues.

3.2.2 Guidelines for Data Acquisition

It is recognized that the Water Resources Branch should be the lead organization with reference to the sediment monitoring program and that it can provide practical recommendations concerning data acquisition for many of those working on topics related to sediment in rivers. For example, the computation of suspended load from periodic suspended sediment concentration measurements can be accomplished through several methods: experience, interpolation techniques, suspended sediment rating curves, etc.

The advantages and disadvantages of the various techniques, presented in written form, could be of use to individuals involved in sediment data acquisition. As another example, individuals wishing to design a field sampling program for characterizing the nature of streambed material may wish to have available a reference document which would recommend number of samples, frequency of sampling, and size of samples required in order to ensure statistical validity of the results.

R.I.5. It is recommended that the experience gained by the Sediment Survey be documented in practical, easily read reports and reference manuals for those wishing to make routine measurements of sediment sizes, and suspended sediment transport.

Some documents are already available or are in the process of development by the Sediment Survey, such as a documentation of the methods of sampling coarse sediment sizes (Yuzyk).

R.I.6. It is recommended that such documents be widely publicized and be made available at a reasonable cost to those working on sediment related problems. Publications in which documents could be publicized include Hydrological Events, Land, Canadian engineering journals, and newsletters of the professional engineering associations and engineering societies.

If it is agreed by those who have to regulate the suspended sediment concentration level in a river that the sampling should be done in the portion of the river in which the sediment is partially or fully mixed across the river, then guidelines may be needed.

R.I.7. It is recommended that the National Water Research Institute be responsible for developing guidelines for sampling the suspended sediment concentration in such cases. Guidelines would be based on known physical laws concerning dispersion in rivers. The distribution of this information should be coordinated through the Water Resources Branch.

During the course of the workshop, it was pointed out that in special cases a significant portion of an extremely fine sediment can pass through the glass filter used to determine the suspended sediment concentration (Jollymore, Waller). In many laboratories the 0.45 micron filter is used to determine the suspended sediment concentration, while in the Atlantic region a different filter size is routinely used by the Environment Canada water quality laboratory (Pollock).

R.I.8. It is recommended that data be obtained to demonstrate the effect of different filter sizes on the reported suspended sediment concentration. Guidelines should be provided to indicate when certain commonly-used filter sizes are to be considered acceptable for determining and reporting suspended sediment concentrations.

3.2.3 Publication Format for Data

The Water Resources Branch at the national level is responsible for publication of suspended sediment data obtained in the regions. The 1984 publication format is restricted in its application for some users in the Atlantic Region. User interpretation would be enhanced through the use of a publication format which provided ready access to instantaneous

measurements of suspended sediment. A new publication format has been introduced for 1985 data reports (Environment Canada, 1986), which became available after the workshop was held.

R.I.9 It is recommended that the Water Resources Branch continue to employ its new publication format which shows the date of sample collection, the time of collection, the instantaneous discharge at time of collection, the water temperature at the time of collection, the value of suspended sediment concentration, and (if available) the value of total dissolved solids.

This method of publication need not show suspended sediment loads, which could be determined by the user of data. It would significantly reduce the dependency of published data on operator interpretation, which presently involves estimation of suspended sediment concentration for all times between the measured values.

Several presentations and discussions at the workshop highlighted the need for land use data to augment the published suspended sediment data. It was noted that the applicability of sediment data was limited due to a frequent lack of understanding of land use changes within the watershed (Chow, Murphy, Sabean). It is recognized that significant inputs of sediment may come from relatively small areas and/or from streambanks; however, in order to improve the applicability of the data collected from suspended sediment monitoring stations,

R.I.10. It is recommended that the Water Resources Branch investigate the practicality of including some basic information on watershed land use types, which could accompany the published data for each sediment station. At a minimum, this information could give 'primary' watershed land use types, such as lakes, swamps, forestry, agriculture, and urban development.

3.2.4 Interpretive Reports for Sediment Stations

The Water Resources Branch at the national level has prepared some interpretive reports for sediment stations in western Canada, such as a recent analysis for the Oldman River (Day and Spitzer, 1985). These reports provide valuable information on land use types in the watershed, long-term trends in sediment loads, seasonal variability of sediment concentrations, bed material data, and other interpretive information. Such interpretive reports would be valuable tools for data users in the Atlantic Region. It is understood that some work is being done at the regional level of the Water Resources Branch to prepare interpretive reports as well.

R.I.11. It is recommended that the Water Resources Branch continue to expand its interpretive report program to include stations in Atlantic Canada. If they are not already being considered for study, candidate sites would include the Kennebecasis River in New Brunswick, the Annapolis River in Nova Scotia, the Wilmot River in Prince Edward Island, and the Waterford River in Newfoundland.

3.3 Category II. Regional Responsibilities of Water Resources Branch Through the Federal/Provincial Coordinating Committees

Recommendations in this category would be the primary responsibility of the Water Resources Branch and the individual provinces. Such recommendations could be developed by a Regional Advisory Group and be put forth at the meetings of the Federal/Provincial Coordinating Committees. Arrangements for suitable cost-sharing could be discussed and agreed upon at that time.

3.3.1 Monitoring Programs

Discussions at the workshop highlighted some deficiencies in the present sediment monitoring programs of the Water Resources Branch. Certain deficiencies are related to quality of data collected, and others are a function of data needs.

The sediment data collected from sediment stations on rivers with watersheds smaller than about 100 km^2 are considered suspect if they are manually collected (Bray). This is because the manual collection method may completely miss the time of peak sediment concentration during intense rainfall-runoff events. In light of this deficiency,

R.II.1. It is recommended that the Water Resources Branch initiate an immediate review of all sediment stations with drainage areas less than 100 km^2, and that some form of automatic monitoring be initiated as soon as possible on those stations for which data are suspect. If this is not possible, the publication of data from those stations with suspect data

should be changed to eliminate the estimates of sediment loads. Out of 17 sediment stations in the Atlantic Region, eight would be reviewed. Review of historic data from inactive sediment stations should also be considered.

During the workshop, needs were expressed, particularly by provincial regulators, for more sediment data in the region and more information concerning the reliability of transferring such data from one area to another (Gilbert). Within the context of the monitoring program, there are two different ways to address these needs: the first is expansion of the baseline "network", while the second is to establish temporary secondary stations in basins already being monitored.

Sediment monitoring stations in Prince Edward Island are within sediment zones; the Province of New Brunswick has initiated monitoring in each of six sediment zones. Nova Scotia and Newfoundland do not as yet have monitoring stations in each identified sediment zone. Therefore,

R.II.2. It is recommended that the Federal/Provincial Coordinating Committees in Nova Scotia and Newfoundland develop expansion plans for their baseline sediment monitoring programs to ultimately include one suspended sediment station in each of the sediment zones identified in the 1970 Ingledow report. Preferably, such zones would be in basins with drainage areas greater than 100 km^2.

In view of the limited information base which presently exists in this region concerning spatial variability of suspended sediment loads

within watersheds,

R.II.3. It is recommended that each of the four Atlantic provinces develop expansion plans which would lead to the installation of one or two secondary sediment monitoring stations (per province) at hydrometric stations within watersheds already monitored further downstream for sediment, or in watersheds which are within the same sediment zone. These secondary stations would be installed for periods of two or three years, and then would be moved to new locations to provide a better spatial sampling of suspended sediment data.

The monitoring program at a baseline sediment station should be evaluated from time to time to determine if continued field measurements are necessary under the existing hydroclimatic regime. Statistical tests should be conducted in those cases where 10 or more years of data have been accumulated. If a baseline station has been designated as a long term "bench mark" station, the monitoring program would continue even if statistical tests indicated that sufficient data had been obtained. Similarly, a monitoring program should continue if it is known that major development and land use changes are anticipated. Therefore,

R.II.4. It is recommended that the Water Resources Branch and the four provinces institute an on-going program of evaluation to determine if a baseline suspended sediment station is continuing to provide useful information.

3.3.2 Awareness of Programs

The workshop highlighted the lack of awareness on the part of sediment data users concerning the research being conducted by the Water Resources Branch, both regionally and nationally (Pollock, Yuzyk). This communication should be improved in order to enhance technology transfer from the researchers to the operational persons.

R.II.5. It is recommended that the Water Resources Branch, with the cooperation of the four provinces, establish a specialized mailing list of individuals in the region who are concerned with freshwater sediment issues. These individuals would receive, by mail, notification of ongoing relevant research and publications by the Water Resources Branch, National Hydrology Research Institute, National Water Research Institute, and other agencies. The members of the proposed Regional Advisory Group could assist in developing such a mailing list.

3.3.3 Regional Advisory Group

The need for official communication links between those collecting freshwater sediment data, those carrying out research, and those using data for engineering design, environmental regulation, or resource management was discussed at the workshop. It was felt that a Regional Advisory Group would be the most appropriate mechanism to develop and ensure effective communication. Therefore,

R.II.6. It is recommended that the Water Resources Branch, with the cooperation of the four provinces, immediately take steps to establish a

Regional Advisory Group on Freshwater Sediment Issues. The primary objective of the proposed Regional Advisory Group would be to serve as a forum for the identification of ongoing freshwater sediment data needs of individuals and agencies in the region. Having identified the data needs, the Group would be able to:

- advise the four Federal/Provincial Coordinating Committees and other agencies which are coordinating data collection efforts as to how freshwater sediment data collection, interpretation, and publication can best be conducted;

- identify requirements for training of personnel in the region concerning the methods of collection and analysis of freshwater sediment data;

- identify what types of research and demonstration projects are required and how and where such projects can be conducted;

- actively promote the conduct of analyses, research, and relevant work within the agencies in the region to effectively address freshwater sediment problems;

- determine how information can be transmitted back to the data users from the researchers in order to meet the changing needs of users in the Atlantic Region;

- assess the need for public education in the area of erosion and sediment control, and advise the responsible agencies on appropriate methods for improving public awareness.

This group would have the structure and general method of operation as described in Appendix III.

3.4 Category III. Responsibilities of Government Departments (federal or provincial) Managing Natural Resources

Recommendations in this category would be carried out at the initiative of the provincial or federal government departments which are responsible for management of natural resources. Assistance for funding, logistical support, or information gathering could be provided by other provincial or federal departments. In some cases, it is likely that funding support could be gained through the regional development sub-agreements for fisheries, forestry, mining, etc.

3.4.1 Resource Evaluation

Several discussions at the workshop focused on "effects" or "impacts" of sediment on freshwater resources, such as water supplies, fisheries, recreation, or aesthetics. Many of these discussions focused on fisheries. For example, individuals from provincial and federal government departments highlighted the "known" or perceived effects of sediment on fish and fish habitat. However, it was recognized that a lack of data exists to quantitatively assess these effects. Furthermore, it was noted that the value of the resources being protected was not always known (Elhadi, LeBlanc, Taylor).

Although suitable information on economic value of resources is not known, provincial and federal agencies have proceeded to develop and apply guidelines for suspended sediment concentrations (Goebel, Elhadi, LeBlanc) which apparently are intended to maintain background water quality for various potential uses, including fish and fish habitat. The relationship between the specified concentrations and the degree of resource protection is not clear. In addition, erosion control measures are being promoted or installed for agricultural lands (Daigle) and for construction activities (Theakston, McCubbin) but little quantitative data seem to be available to relate the costs of these works to the resultant environmental benefits. In view of this deficiency,

R.III.1. It is recommended that the federal or provincial agencies be responsible for evaluating the resource which they are trying to protect through erosion/sediment control measures and guidelines/regulations for suspended sediment concentrations in streams. Such resource evaluations would develop dollar values of important resources; ultimately they would permit the comparison of the costs of sediment control and the benefits of resource protection.

3.4.2 Demonstration Projects

Gaps in knowledge of sediment processes in the region were highlighted at the workshop. Some of these gaps were seen to separate one sector of activity from another. For example, the rate of soil loss from the land and subsequent movement of sediment towards the river channel is of fundamental importance to the agricultural community, whereas the quantity

of sediment entering the channel and the portion transported downstream is of more interest to water resource managers or individuals concerned with fisheries protection. The connection between these processes, the sediment delivery ratio, is poorly understood for many locations in the region (Gartley).

Several other gaps in knowledge were brought out in workshop discussions. Although erosion of soils under freezing/thawing conditions have been initiated in this region (Burney, Edwards), additional work needs to be carried out to determine the relative significance of the freezing/thawing sequence on annual soil loss. The threshold values of suspended sediment concentration above which fish are significantly adversely affected are important for establishing concentration limits, but are not well understood (LeBlanc). The connection between instream transport of fine (sand and silt) particles and interaction with a gravel bed is poorly understood (Sabean). The time over which movement of fine particles takes place in the stream bed, following introduction of particles from anthropogenic activity, is not well documented (Groenewoud).

In noting these gaps in knowledge, it was felt that demonstration projects could be used to generate useful data, relatively quickly, with funding requirements that would be more reasonable than the costs of conducting long-term basic research. Therefore,

R.III.2. It is recommended that demonstration projects be initiated with a view to obtaining support from the provincial or federal departments

with the most direct concern for the processes being studied, along with support through such funding mechanisms as may be available, to investigate the following problems:

1. freeze-thaw effects for exposed soils;
2. sediment delivery ratios;
3. threshold limits for suspended sediment concentration;
4. influx of fines into gravel bed.

4.0 REFERENCES

Day, T.J. and M.O. Spitzer. 1985. Sediment station analysis, Oldman River near Brocket. Sediment Survey Section, Water Resources Branch, Environment Canada, Ottawa, Ont. 54 p + app.

Environment Canada. 1986. Sediment data Atlantic Provinces 1984. Inland Waters Directorate, Water Resources Branch, Ottawa, Ont. 77 p.

Washburn & Gillis Associates Ltd. 1985. Freshwater sediment data collection and use in the Atlantic provinces. Prepared for Inland Waters Directorate, Water Resources Branch, Environment Canada, Dartmouth, N.S.

APPENDIX I

LIST OF WORKSHOP PARTICIPANTS

This appendix provides a list of the names, affiliations, addresses and phone numbers of the 41 individuals who participated in the Workshop on Freshwater Sediment Issues. Names are presented in alphabetical order.

Mr. D.C. Ambler
Senior Project Engineer, Water Resources Branch
Inland Waters Directorate, Environment Canada
45 Alderney Drive
Dartmouth, N.S.
B2Y 2N6
902-426-5776

Mr. J. Arbour
Lands Division, Environment Canada
45 Alderney Drive
Dartmouth, N.S.
B2Y 2N6
902-426-4196

Mr. F. Baechler
Ground and Surface Water Hydrologist
Nolan, Davis and Associates Ltd.
P.O. Box 1688
Sydney, N.S.
B1P 6R7
902-562-2394

Dr. D.I. Bray
Professor, Department of Civil Engineering
University of New Brunswick
P. O. Box 4400
Fredericton, N.B.
E3B 5A3
506-453-4521

Dr. J.R. Burney
Head, Department of Agricultural Engineering
Technical University of Nova Scotia
P. O. Box 1000
Halifax, N.S.
B3J 2X4
902-429-8300 ext 193

Dr. L. Chow
Research Scientist, Soil Physics
Agriculture Canada Research Station
P. O. Box 20280
Fredericton, N.B.
E3B 4Z7
506-452-3260 ext 281

Mr. J.L. Daigle
Soil Conservation Engineer
N. B. Department of Agriculture
P. O. Box 5001
Grand Falls, N.B.
E0G 1M0
506-473-5515

Mr. R. DeHaan
Soil and Water Engineer
P.E.I. Department of Agriculture
P.O. Box 1600
Charlottetown, P.E.I.
C1A 7N3
902-892-5465

Mr. Jean-Guy Deveau
Assistant Regional Engineer
Water Survey of Canada, Environment Canada
45 Alderney Drive
Dartmouth, Nova Scotia
B2Y 2N6
902-426-5776

Dr. T.M. Dick
Director
Hydraulics Division, National Water Research Institute
Canada Centre for Inland Waters
P.O. Box 5050, Burlington, Ont.
L4R 4A6
416-336-4738

Dr. L.M. Edwards
Research Scientist, Soil Management Section
Research Station, Agriculture Canada
P.O. Box 1210
Charlottetown, P.E.I.
C1A 7M8
902-892-5461

Dr. N. Elhadi
Chief, Surface Water Section, Water Resources Branch
N.B. Department of Municipal Affairs and Environment
P. O. Box 6000
Fredericton, N.B.
E3B 5H1
506-453-2353

Mr. R.M. Francis
Chief, Water Resources Section
P.E.I. Department of Housing, Community and Cultural Affairs
P. O. Box 2000
Charlottetown, P.E.I.
C1A 7N8
902-892-0311

Mr. C. Gartley
Chief, Soil and Water Section, Engineering Branch
N. B. Department of Agriculture
P. O. Box 6000
Fredericton, N.B.
E3B 5H1
506-453-2691

Mr. J. Gilbert
Biologist
New Brunswick Department Natural Resources and Energy
P. O. Box 6000
Fredericton, N.B.
E3B 5H1
506-453-3304 direct; 453-3755 general

Mr. G.F. Gillis
Biologist
Washburn & Gillis Associates Ltd.
404 Queen Street
Fredericton, N.B.
E3B 1B6
506-458-1000

Mr. M. Goebel
Water Resources Engineer
Newfoundland Department of the Environment
P. O. Box 4750
St. John's, Newfoundland
A1C 5T7
709-576-5713

Mr. N.C. Gridley
Environmental Engineer
Porter Dillon Limited
Suite 202, 2651 Dutch Village Road
Halifax, Nova Scotia
B3L 4G5
902-453-1115

Mr. D. Hache
Engineer, Fish Habitat Division
Fisheries & Oceans Canada
P.O. Box 5030
Moncton, New Brunswick
E1C 9B6
506-857-6226

Mr. D. Hansen
Graduate Student, Department of Civil Engineering
University of New Brunswick
P.O. Box 4400
Fredericton, N.B.
E3B 5A3
506-453-4521

Mr. P. Helwig
Hydrotechnical Department
ShawMont Newfoundland Ltd.
P. O. Box 9600
St. John's, Newfoundland
A1C 3C1
709-754-0250

Mr. B. Jollymore
Hydrologist
Fisheries & Oceans Canada
P. O. Box 550
Halifax, Nova Scotia
B3J 2S7
902-426-2549

Mr. P. LeBlanc
Chief, Fish Habitat Division
Fisheries & Oceans Canada
P.O. Box 5030
Moncton, New Brunswick
E1C 9B6
506-857-6226

Mr. L. Lewis
Chief, Water Management Section
Nova Scotia Department of the Environment
P. O. Box 2107
Halifax, N.S.
B3J 3B7
902-424-5300

Mr. R. MacLennan
Watercourse Engineer
Nova Scotia Department of the Environment
P.O. Box 824
Truro, N.S.
B2N 5G6
902-895-9266

Mr. R. McCubbin
Biologist, Habitat Research and Assessment Section
Fisheries & Oceans Canada
P. O. Box 5667
St. John's, Newfoundland
A1C 5X1
709-772-4540

Mr. P. Milburn
Drainage Engineer
Research Station, Agriculture Canada
P. O. Box 20280
Fredericton, N.B.
E3B 4Z7
506-452-3260

Mr. D. Morantz
Fisheries Biologist
Fisheries & Oceans Canada
P. O. Box 550
Halifax, N.S.
B3J 2S7
902-426-2480

Mr. C. Murphy
Chief, Marine Environment Section
P.E.I. Department of Housing, Community and Cultural Affairs
P. O. Box 2000
Charlottetown, P.E.I.
C1A 7N8
902-892-0311

Mr. R. Myslik
Regional Engineer
Water Survey of Canada, Environment Canada
75 Farquhar Street
Guelph, Ontario
N1H 3N4
519-821-0110

Dr. T. Pollock
Water Quality Branch
Inland Waters Directorate, Environment Canada
P. O. Box 861
Moncton, N.B.
E1C 8N6
506-857-6606

Mr. D. Randall
Regional Engineer
Water Survey of Canada, Environment Canada
45 Alderney Drive
Dartmouth, Nova Scotia
B2Y 2N6
902-426-5776

Mr. B. Sabean
Biologist
Nova Scotia Department of Lands and Forests
P. O. Box 516
Kentville, Nova Scotia
B4N 3X3
902-678-8921

Mr. D.G. Taylor
Environmental Supervisor
Sable Gas Systems Limited
P. O. Box 462, Station M
Halifax, N.S.
B3J 2P8
902-421-3103

Mr. J. Theakston
Engineer, Water Rights Division
Nova Scotia Department of the Environment
P. O. Box 2107
Halifax, N.S.
B3J 3B7
902-424-5300

Mr. T. Toner
Biologist
Nova Scotia Power Corporation
P. O. Box 910
Halifax, Nova Scotia
B3J 2W5
902-428-6744

Dr. H. Van Groenewoud
Forest Hydrologist, Maritimes Forest Research Centre
Environment Canada
P. O. Box 4000
Fredericton, N.B.
E3B 5P7
506-452-3581

Mr. C. Veer
Land Resources Research Institute
Agriculture Canada
P.O. Box 1210
Charlottetown, P.E.I.
C1A 7M8
902-892-5461

Ms. G. Vessey
Soil Scientist
P.E.I. Department of Agriculture
P. O. Box 1600
Charlottetown, P.E.I.
C1A 7N3
902-892-5465

Dr. D. Waller
Professor, Department of Civil Engineering
Technical University of Nova Scotia
P. O. Box 1000
Halifax, N.S.
B3J 2X4
902-429-8300 ext 2246

Mr. T. Yuzyk
Sediment Survey Section
Inland Waters Directorate, Water Resources Branch
Environment Canada
Ottawa, Ontario
K1A 0E7
819-997-1185

APPENDIX II

ORIGINAL ABSTRACTS AND RESPONSES TO QUESTIONS RAISED TO PRESENTORS DURING THE WORKSHOP AVAILABLE UPON REQUEST FROM THE WATER RESOURCES BRANCH, INLAND WATERS AND LANDS, CONSERVATION AND PROTECTION, ENVIRONMENT CANADA, DARTMOUTH, NOVA SCOTIA

APPENDIX III

REGIONAL ADVISORY GROUP

OBJECTIVES AND STRUCTURE

The need for official communication links between those collecting freshwater sediment data, those carrying out research, and those using data for engineering design, environmental regulation, or resource management was discussed at the workshop. It was felt that a Regional Advisory Group would be the most appropriate mechanism to develop and ensure effective communication.

As established during the workshop discussions, during a working session, and as a result of followup deliberations, the following objectives and structural arrangements are suggested for the Regional Advisory Group on Freshwater Sediment Issues.

Objective and Goals

The primary objective of the proposed Regional Advisory Group would be to serve as a forum for the identification of ongoing freshwater sediment data needs of individuals and agencies in the region. Having identified the data needs, the Group would be able to:

- advise the four Federal/Provincial Coordinating Committees and other agencies which are coordinating data collection efforts as to how freshwater sediment data collection, interpretation, and publication can best be conducted;

- identify requirements for training of personnel in the region concerning the methods of collection and analysis of freshwater sediment data;

- identify what types of research and demonstration projects are required and how and where such projects can be conducted;

- actively promote the conduct of analyses, research, and relevant work within the agencies in the region to effectively address freshwater sediment problems;

- determine how information can be transmitted back to the data users from the researchers in order to meet the changing needs of users in the Atlantic Region;

- assess the need for public education in the area of erosion and sediment control, and advise the responsible agencies on appropriate methods for improving public awareness.

Structure of the Advisory Group

Alternative group structures would include four (one for each province), two (one for N.B./P.E.I. and another for N.S./Nfld.), or one. Having considered the alternatives, the concept of one group serving all provinces is strongly recommended. The composition of such a group would be:

- one provincial environment representative from each province (4)
- one DFO representative from each DFO region (3)
- one forestry sector representative speaking for the region (1)
- agriculture sector representatives from NS, NB, PEI and perhaps Newfoundland (3 or 4)
- university representative speaking for the region (1)
- a representative from industry/consulting (1)
- Water Resources Branch (1)

The total membership would be In the order of 13 persons. Membership would be rotating and no one person, with the exception of the Water Resources Branch representative, would serve for more than two consecutive years.

Reporting Structure

The Regional Advisory Group would report primarily to the Water Resources Branch. Information obtained by WRB would be passed along to the appropriate agencies. Some agencies would be represented on the group itself, and information could be passed along in that fashion as well.

Frequency of Meetings and Self-review Period

Meetings of the Advisory Group could be once a year or more frequent if desired. Members of the group would be kept informed through mailings. At the end of five years, the progress of the Advisory Group would be reviewed to determine if it should be continued.

Timing of meetings would be selected to ensure that group recommendations could be passed along to the funding agencies at the appropriate times in their fiscal year planning.

Funding Support

Individuals would participate on the group as volunteers. Those individuals from federal or provincial government departments would be sent to meetings at the approval of their supervisors. Those from industry, consulting or university would also take part with the approval of their employers.

Travel expenses for individuals from government would be borne by the individuals' own departments. Travel expenses for individuals from industry, consulting, or university would be paid for at cost by WRB.

Recordkeeping and Ongoing Contact

A secretary would be appointed to the group. This individual would most likely be from the WRB, and the costs for that individual would be borne by WRB. WRB would be responsible for recording meeting notes, mailing them out to members, incorporating changes to them, etc. WRB would also be responsible for contacting members in advance of meetings and for arranging meeting dates and locations.

Some of the above functions may be performed by a consultant, whose fees would be paid for by WRB.